*FERTILISATION OF FLOWERS BY INSECTS**

VI.

Different Modes of Self-fertilisation where Visits of Insects are wanting

THE two functions of cross-fertilisation and self-fertilisation, which in the previous articles we have seen to occur in different forms of the same species or genus, are in most cases successively presented by the same form of flower; and the modifications by which self-fertilisation is attained by different plants, where visits of insects are wanting, are almost as various as the contrivances by which cross-fertilisation by insects is secured. Of these various modes I shall here speak only of some not yet referred to in my book on fertilisation.†

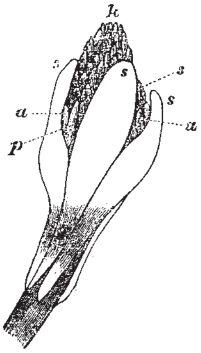

FIG. 32.

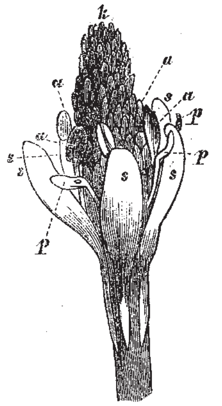

FIG. 33.

FIG. 32.—Side view of flower of *Myosurus minimus* before opening. FIG. 33.—Side view of a flower just open.

Myosurus minimus is as remarkable for the great variability in the size of its flower (compare Figs. 35 and 38) and in the number of its parts,‡ as for the enormous growth of the cone of pistils, which affords no other benefit to the plant but the self-fertilisation of the greater part of the numerous stigmas by the small number of anthers, in case it is not visited by insects.

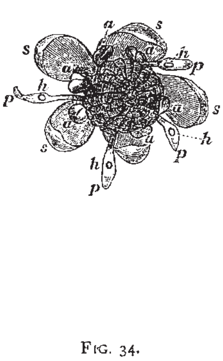

FIG. 34.

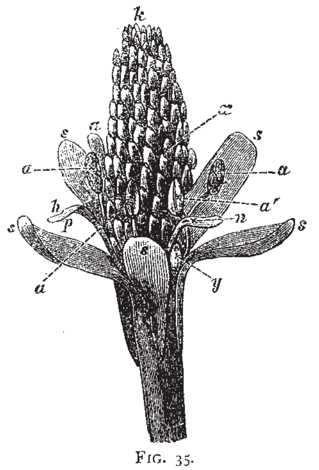

FIG. 35.

FIG. 34.—The same flower viewed from above. FIG. 35.—Side view of a somewhat older flower.

When the flower opens, it stretches forth its small petals (*p*), which serve as nectaries (*n*), and offer a small drop of honey (*h*), by which very minute insects are attracted in sunny weather. These visitors are for the most part Diptera not exceeding 1-1½ mm. in length, belonging to the genera Sciara, Chironomus,* Hydrellia,* Scatopse,† Phora, Cecidomyia, Oscinis, and Microphorus. I observed also a single specimen of *Melanostoma mellina* (Syrphidæ), some Anthomyia (Muscidæ), a small Haltica, some Pteromalidæ, and small Ichneumonidæ. These minute visitors licking up the drops of honey, and walking round the cones of ovaries, stop many seconds in a single flower before visiting another. The anthers, lying close round the cone of ovaries, open by two lateral slits, and are soon afterwards covered with pollen on their whole outside; consequently, insects walking round the ovaries may easily be charged with pollen, and flying to another flower effect cross-fertilisation. But, upon the whole, the flowers, because of their being scentless and very inconspicuous, are so scantily visited by insects, that, after repeated careful examinations, I believe that even in sunny weather more than 90 per cent. of the flowers remain without any visit. This deficiency of secured cross-fertilisation is supplied by regular self-fertilisation in the following manner. The axis of the flower, extending gradually during the blooming-time into a long cone, brings a great part of the stigmas into contact with the lateral pollen-grains of the anthers; those ovaries which now are in contact with the anthers soon afterwards overgrowing them, and others now below the anthers reaching them.‡ Thus a number of styles grazing the anthers during the growth of the long cone are self-fertilised by about five or more pollen-grains (Fig. 36); besides, also, the lowest stigmas of the flowe are fertilised by their own pollen, many pollen-grains falling down from the anthers (Fig. 35 *y*, Fig. 37). Consequently, only those ovaries are never self-fertilised which

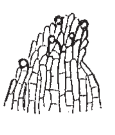

FIG. 36.

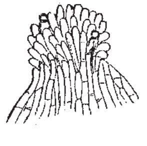

FIG. 37.

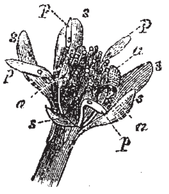

FIG. 38.

FIG. 36.—Stigma of the ovary *x*, Fig. 35, provided with pollen-grains from the anther *a'*, which have already emitted their pollen-tubes. FIG. 37—Stigma of the ovary *y*, Fig. 35, more developed than the stigma, Fig. 36, provided with two pollen-grains fallen down from the anther *a'*. FIG. 38.—One of the smallest flowers: *s*, sepal, *p*, petal, *n*, nectary, *h*, honey, *k*, cone of ovaries. FIGS. 32–35 and 38, seven times natural size.

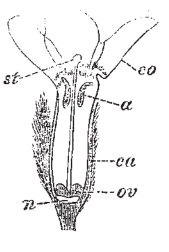

FIG. 39.

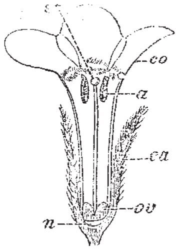

FIG. 40.

FIG. 39.—Flower of *Myosotis versicolor* when just opened, dissected longitudinally. FIG. 40.—An older flower, with full-grown corolla (seven times natural size): *ca* calyx, *co* corolla, *a* anthers, *st* stigma, *n* nectary, *ov* ovary.

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* Continued from vol. ix. p. 166.

† "Die Befruchtung der Blumen durch Insecten," Leipsig, 1873.

‡ I examined a hundred flowers as to the number of sepals, petals, and anthers, and found the number of sepals in 3 flowers = 4, in 94 flowers = 5, in 3 flowers = 6; petals in 2 flowers = 2, in 20 flowers = 3, in 3 flowers = 4, in 35 flowers = 5; anthers in 2 flowers = 3, in 2 flowers = 4, in 11 flowers = 5, in 22 flowers = 6, in 31 flowers = 7, in 46 flowers = 8, in 5 flowers = 9, in 1 flower = 11.

* For instance, *Chironomus byssinus* Schrk., *Hydrellia chrysostoma* Meig., and *griseola* Fall., after Prof. Mik's (of Vienna) examination.

† *Scatopse brevicornis* Löw.

‡ This is easy to be seen by marking some of the ovaries with a spot of ink.

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are already situated above the anthers before the opening of the flower.

Whilst in *Myosurus minimus* self-fertilisation is effected by a number of stigmas passing along each of the anthers, *Myosotis versicolor* attains the same effect in the contrary way, all five anthers of the flower passing along the single stigma.

The corolla, when opening, is not only still of a pale yellowish colour, like the buds of other species of Myosotis, but even when not yet fully developed the anthers and pistils are mature at the same time and the stigma slightly overtops the corolla. Hence when insects visit the flowers in this state, their probosces always touch the stigma sooner than the anthers, and consequently, when flying to another flower, always cross-fertilise it.

But by the gradual lengthening of the corolla-tube the anthers affixed to its inner side are raised till they surround and self-fertilise the stigma now enclosed in the corolla (Fig. 40). Thus also in this inconspicuous flower the defective cross-fertilisation by insects * is largely supplied by regular self-fertilisation.

HERMANN MÜLLER

INTERNATIONAL METRIC COMMISSION AT PARIS

Melting of the Metal for the new Metric Standards

AT the meeting of the Executive Committee of the International Metric Commission in October last, the fusion of the large single ingot of platinum-iridium, weighing 250 kilogrammes, out of which all the new metric standards were to be constructed, was fixed for the end of the following April, but the completion of the operation was delayed by accidental circumstances until the middle of the following month. As this was the first occasion on which any attempt had ever been made to melt together more than a few kilogrammes of platinum or of platinum alloyed with iridium, it was necessary to make a great number of experimental meltings during the intermediate time in order to secure success in the great operation.

All the actual meltings of the platinum and iridium have been made at the Conservatoire des Arts et Métiers, in a building erected for the purpose. The work has been carried out under the superintendence of M. Tresca, the Sous-Directeur of the Conservatoire, who is also honorary secretary of the Commission, and more immediately intrusted with the technical operations of constructing the new standards. He has had the advantage of the cordial assistance of Mr. George Matthey, of the firm of Johnson and Matthey, Hatton Garden, from whom the large mass of platinum and iridium was obtained. Mr. G. Matthey has had large personal experience in melting platinum, and he remained at Paris from the beginning of April assisting in the work.

It was necessary that the whole of the platinum and iridium should be separately assayed and purified previously to their being melted together. This process was entrusted to M. Henri Sainte-Claire Deville, and carried out at the Ecole Normale, of which he is director. The greatest difficulty in the purification consisted in getting rid of the osmium, which is found in the natural ore in combination with platinum and with iridium. But the chemical difficulty was satisfactorily overcome by M. Deville after many experiments made by him.

The whole of the platinum and iridium had thus been ascertained to be perfectly pure when delivered to M. Tresca for melting. The first process was to melt portions of the pure platinum, its melting point being about 1,900° C., and considerably lower than that of iridium, which is about 2,400° C. Portions of the platinum were then remelted together with iridium, in the proportions fixed upon of 90 per cent. of platinum and 10 per cent. of iridium. Quantities of from 10 to 15 kilogrammes of platinum-iridium were, in the first instance, melted together. Several of these smaller ingots were then remelted into larger ingots of rather more than 80 kilogrammes each, and the final operation was to remelt three of these larger ingots into a single ingot of 250 kilogrammes.

Each of the meltings was made as nearly as possible of uniform form in a furnace heated with oxy-hydrogen gas. The furnace was made of a block of the ordinary sandy limestone used for buildings in Paris. For the smaller ingots a square block of stone was employed with a hemispherical cavity about 6 in. (15 centimetres) in diameter, for containing the metal. This small block had a cover of similar form, and through its middle was a vertical hole, about ¾ in. in diameter, in which the tube for conveying the gas was fixed with mortar. When the metal was placed in the furnace, and the jet of lighted gas directed upon it, sufficient mortar was placed on the joining of the upper and lower blocks of stone to make it air-tight. For the three larger ingots a long oblong furnace was used, with a cavity of the same breadth, but a little deeper and much longer, and three gas-tubes were used. The largest furnace required for the whole quantity of metal had six gas-tubes, each about 1 in. in diameter, inserted in the upper block. The ordinary illuminating gas was used, mixed with the requisite proportion of oxygen gas, made on the premises and stored in a large gasometer placed near the furnace-room. For obtaining a sufficient blast the power of a 15-horse steam-engine was employed.

In order to facilitate the melting, it was necessary first to divide the larger ingots into small pieces. About half the quantity for a single melting, thus divided into small lumps, was placed in the mould, and when this was completely melted the remainder, which had been drawn out into long thin bars, was introduced gradually through two small holes opposite each other in the furnace. These holes also enabled the interior of the furnace to be seen, together with the progress of the melting, and they could be closed by stone plugs when requisite. The division of the ingots was a difficult operation, as this alloy of platinum and iridium is harder than ordinary steel. A V cut, about ⅛ in. deep, was made around the ingot with a cold chisel, though not without splintering the edges of a considerable number of the best-tempered chisels. The ingot was then placed under a hydraulic press, supported upon the rounded tops of two strong iron bars, a sufficient distance apart. The rounded part of a third bar was placed upon the ingot, in the line of the cut, and the power of the press being applied, the ingot was broken in half, presenting in every instance a regular crystallised grain.

The melted metal was not cast into a separate mould, but was allowed to cool in the furnace. During the melting a portion of the interior of the stone, to the depth of about half an inch, became coloured by the excessive heat and formed into lime in a powdery state, which floated on the surface of the melted metal. When the metal was sufficiently cool, the stone mould was broken and the ingot removed to a bath of hydrochloric acid, which dissolved every portion of lime or other foreign matter upon the surface of the ingot, but does not act upon platinum-iridium. The ingot was then left quite clean and pure.

The first of the larger ingots of 80 kilogrammes was successfully melted on April 25. The second was melted on May 1, when Marshal MacMahon, the President of the

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* After having repeatedly watched in vain the flowers of *Myosotis versicolor*, I succeeded twice in seeing it fertilised by insects, viz.—May 15, 1873, I observed *Bombus agrorum* F. ♀, and June 2, 1873, *Halictus sexnotatus* K. ♀, *H. zonulus* Sm. ♀, *Rhingia rostrata* L., and *Syritta pipiens* L., all of them successively sucking flowers of different stems. But certainly by far the greatest part of all the flower remains without any visit of insects.

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